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AD-A276 975

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ASC-TR-94-5018

DOCUMENT IDENTIFICATION

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Distribution Unlimited

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DTIC ELECTE MAR 10 1994 C

DATE ACCESSIONED

DATE RETURNED

94 3 9 106

DATE RECEIVED IN DTIC

94-07851

REGISTERED OR CERTIFIED NUMBER

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ASC-TR-94-5018

MODULAR SIMULATOR SYSTEM (MSS)

SYSTEM/SEGMENT SPECIFICATION FOR THE GENERIC MODULAR SIMULATOR SYSTEM - RADAR MODULE

VOLUME 8

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AUGUST 1994

FINAL REPORT

SYSTEMS ENGINEERING DIVISION
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REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	13 Aug 93	FINAL

4. TITLE AND SUBTITLE
System/Segment Specification for the Generic Simulator System-Radar Module Volume 8

5. FUNDING NUMBERS
F33657-86-C-0149
64227F

6. AUTHOR(S)
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8. PERFORMING ORGANIZATION REPORT NUMBER
S495-10400D

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Aeronautical Systems Center
Systems Engineering Division
Bldg 11 2240 B St Ste 7
Wright-Patterson AFB, OH 45433-7111

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
ASC-TR-94-5018

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release;
distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This is the Radar portion of the generic Modular Simulator System (MSS) specification. It is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. This specification contains specific tailoring instructions for each paragraph. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by application specific text or deleted from the specification. It is suggested that the user read the "Modular Simulator Engineering Guide" and the "Modular Simulator Management Guide" prior to tailoring this volume.

14. SUBJECT TERMS
Modular Simulator System (MSS)

15. NUMBER OF PAGES
33

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

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PREFACE

This generic Modular Simulator System (MSS) segment specification has been developed in accordance with DI-CMAN-80008A, Data Item Description for System/Segment Specifications. This specification meets or exceeds the requirements for MIL-STD-490, Type A, specifications. This specification is designed to be tailored to specify the requirements for a specific aircraft training device or family of aircraft training devices. Training devices may consist of Weapon System Trainers (WST), Operational Flight Trainers (OFT), Cockpit Procedures Trainers (CPT), Part Task Trainers (PTT), etc.

Tailoring will be necessary to meet specific application requirements. The tailoring must be accomplished so as not to violate the goals and intent of the MSS concept. It is assumed that the user of this document has a familiarity with the MSS design concepts and architecture, the application aircraft training requirements, and general working knowledge of aircraft training systems. It is suggested that the user read the "Modular Simulator System Engineering Design Guide" (D495-10440-1) and the "Modular Simulator System Management Guide" (D495-10439-1) prior to tailoring this specification. These guides provide an overview of the MSS architecture, an in-depth discussion on its application, and lessons learned from previous applications.

Each segment in the MSS architecture provides a portion of the overall system functionality. Similar functions and operations were grouped in each segment based on past experience, areas of design expertise, and management of intersegment communication. To promote reuse of the segments and gain the maximum benefits of using the MSS approach, it is suggested that user adhere to the generic functional allocation. Interfaces between the segments should remain relatively constant from application to application. The application vehicle is considered to be an air vehicle (e.g. fixed wing, variable geometry, or rotary wing), although the MSS architecture and concepts may be applied to either ground or sea vehicles.

This specification contains specific tailoring instructions for each paragraph. The instructions are contained within the paragraphs, and are identified by blank spaces and/or italicized text. When the tailoring process is complete, the italicized tailoring instructions should have been replaced by the application specific text or deleted from the specification. Paragraphs which do not apply to a particular application should not be deleted. They should be identified as "Not Applicable" to maintain paragraph numbering consistency between volumes and various MSS applications.

1. SCOPE

1.1 Identification. This segment specification establishes the requirements for the Radar segment of the _____ *(insert application aircraft type)* Modular Simulator System (MSS). This volume is one of ____ *(insert number of volumes of the application system segment specification)* volumes which comprise the system/segment specification for the _____ *(insert application aircraft type)* MSS. Volume I of this specification contains system level requirements such as MSS structure, communication architecture, network interface performance, system level diagnostic and test requirements, Ada programming language applicability, adaptability and expandability, and other requirements which pertain to all volumes.

1.2 System Overview. The purpose of the Radar segment is to simulate the Radar functions within the _____ *(insert application aircraft type)* MSS. The Radar segment interfaces with other MSS segments as described in the _____ *(insert application aircraft type)* Interface Design Document (IDD) _____ *(insert IDD document number)*. Each of the Radar functions identified in this volume are to be processed within the Radar segment.

(This paragraph should be modified to specify the types of radar capabilities which will be required for the application simulator. These may include: ground map, beacon detect, terrain following, moving target indicator, etc.)

1.3 Document Overview. This segment specification defines Radar segment unique requirements for the _____ *(insert application aircraft type)* MSS. It contains requirements for the functions performed within the segment including communication interface requirements, segment performance requirements, segment diagnostic and test requirements, and expandability and adaptability requirements as applicable to the Radar segment.

2. APPLICABLE DOCUMENTS

2.1 Government Documents. The following documents, of the exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The Government documents, applicable to the _____ *(insert application aircraft type)* MSS, are listed in Volume I of this specification. The following Government documents are in addition to those documents, and are specifically applicable to the _____ *(insert application aircraft type)* MSS Radar segment.

SPECIFICATIONS:

Federal - *(Identify applicable federal specifications)*
Military - *(Identify applicable military specifications)*
Other Government Agency - *(Identify applicable government specifications)*

STANDARDS:

Federal - *(Identify applicable federal standards)*
Military - *(Identify applicable military standards)*
Other Government Agency - *(Identify applicable government standards)*

DRAWINGS: *(Identify applicable government drawings)*

OTHER PUBLICATIONS:

Manuals - *(Identify applicable government manuals)*
Regulations - *(Identify applicable government regulations)*
Handbooks - *(Identify applicable government handbooks)*
Bulletins - *(Identify applicable government bulletins)*

Copies of specifications, standards, handbooks, drawings, publications and other Government documents required in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.

(In this paragraph, list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to a reference in a system/segment specification Volume I paragraph, and that paragraph contains a reference, the document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

2.2 Non-Government Documents. The following documents, of the exact issue shown, form a part of this specification to the extent specified herein. In the event of conflict between the documents reference herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

The non-Government documents applicable to the _____ *(insert application aircraft type)* MSS are listed in Volume I of this specification. The following non-Government documents are in addition to those documents, and are specifically applicable to the _____ *(insert application aircraft type)* MSS Radar segment.

SPECIFICATIONS: *(Identify applicable non-government specifications)*
STANDARDS: *(Identify applicable non-government standard)*
DRAWINGS: *(Identify applicable non-government drawings)*
OTHER PUBLICATIONS: *(Identify applicable non-government publications)*

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

(In this paragraph list only those documents which are explicitly referenced within this specification volume. If a requirement paragraph is tailored to reference a system/segment specification Volume I paragraph, and that paragraph contains a reference, the secondary document should not be listed here. All requirements and references in system/segment specification Volume I are requirements of this specification unless specifically excluded in this volume.)

3. REQUIREMENTS

3.1 Segment Definition. The Radar segment shall provide the capabilities to simulate _____ *(insert application aircraft type)* aircraft radar system. The Radar segment is one of _____ *(insert number of segments to be used in the application simulation)* unique segments which comprise the _____ *(insert application aircraft type)* MSS. The Radar segment shall provide the modes, states, and functions as defined in this specification volume and Volume I.

The Radar segment shall provide the real-time simulation of the _____ *(insert application aircraft type)* Radar subsystem. This segment shall provide operation and control representative of both normal and degraded states. The Radar segment shall provide simulation/stimulation for the radar processors, display subsystem, and data management.

(This paragraph should be tailored to convey the exact top level functions required of the segment. If this segment is to be used/reused on several devices within a family of trainers, that should be stated here with any unique performance requirements.)

3.2 Characteristics

3.2.1 Performance Characteristics. Performance of the Radar segment shall be as specified herein and in accordance with _____ *(insert application aircraft type)* aircraft design criteria. The Radar segment shall simulate functions associated with the _____ *(insert application aircraft type)* aircraft radar system. The fidelity of the Radar segment shall be sufficient to provide the necessary level of training as specified in Volume I, paragraph 6.1 of this specification.

(Several considerations must be addressed in this paragraph:

a. Availability of specific and traceable Radar system design and engineering data
b. Manufacture of specific Radar equipment.

Additional text should be added to this paragraph to identify the design criteria and specific Radar equipment to be simulated. A general statement with respect to the fidelity of the simulation should be added.)

3.2.1.1 Segment Modes and States. The Radar segment shall support the modes and states as described in Volume I of this specification. Additional requirements or operations shall not cause degradation of the system nor violate the intent of the system mode or state.

(Introduction of new modes is prohibited. Functions should be accomplished within the established modes and states. This paragraph should be tailored to describe the segment's

response to a given mode or state. Subparagraphs should be added to identify and define segment requirements for each mode and state.)

3.2.1.2 Radar Segment Functions. Functions characterized as "Implemented" shall be implemented, within the Radar segment, to the extent described by the paragraphs dedicated to those functions. Functions characterized as "Not Applicable" do not exist in the simulation of the _____ *(insert application aircraft type)*, and are not required to be implemented in any form within the Radar segment.

a.	Radar Segment Support Function	Implemented
b.	Radar Processor Function	*(Implemented, N/A)*
c.	Radar Image Generation Function	*(Implemented, N/A)*
d.	Airborne Interrogate Sensor Function	*(Implemented, N/A)*
e.	Radar Database Management Function	Not Applicable
f.	Radar Guidance Function	*(Implemented, N/A)*
g.	Mission Computer Interface Function	*(Implemented, N/A)*
h.	Radar Aircraft Systems Interface Function	*(Implemented, N/A)*
i.	Crew Station Hardware Interface Function	*(Implemented, N/A)*
j.	Spatial Relations Function	Not Applicable
k.	Occulting Function	Not Applicable

(Each function listed should be characterized as "Implemented" or "Not Applicable (N/A)").

3.2.1.2.1 Radar Support Function. The Radar support function shall provide segment unique support services required for operation of the Radar segment in the MSS environment. The Radar support function services shall include the functions listed below, and as described in the following paragraphs.

a. Executive Control
b. Initialization
c. MSS Virtual Network (VNET) Communication
d. Diagnostics and Test
e. Backdoor Interfacing
f. Malfunctions
g. Damage Assessment
h. Security Processing
i. Scoring
j. Other Support Function Services.

3.2.1.2.1.1 Executive Control. The executive control support service shall provide operational control for the Radar segment. This control shall include: execution sequencing of all software segments, mode and state control, and communication between the simulation software and the VNET.

(For most applications this paragraph will require no tailoring. If additional or specific executive control functions are required, they should be identified in this paragraph.)

3.2.1.2.1.2 Initialization. The initialization support service shall control initial hardware and software states for the Radar segment. System initialization shall occur during power-up and system resets, as defined in Volume I of this specification. The initialization function shall access mission initialization data, and transfer the data to other segment functions for mission initialization.

(Initialization requirements unique to the application aircraft Radar systems should be specified in this paragraph. Initialization refers to setting initial hardware and software states during power-up and system resets as defined in Volume I. Instrument scale factors and default instrument settings (usually powered off) are typically initialized by this function. A second initialization function is to access mission initialization data (for example from disc) to pass to other segment functions for mission initialization.)

3.2.1.2.1.3 MSS Virtual Network Communication. The MSS VNET communication support service shall provide the Radar segment interface to the VNET. It shall allow communication with other segments in the _____ *(insert application aircraft type)* MSS. The Radar segment shall communicate on the MSS VNET in accordance with the protocol requirements defined in the _____ *(insert application aircraft type)* MSS IDD, _____ *(insert MSS IDD document number).*

3.2.1.2.1.4 Diagnostics and Test. The diagnostics and test support service shall provide control for the diagnostic and test functions incorporated into the Radar segment. Diagnostic and test requirements, for the Radar segment, shall be in accordance with the requirements specified herein.

(Based upon the specific simulator diagnostic requirements, all or part of the three types of diagnostic capabilities may be required. "Not applicable "should be inserted if the specific diagnostic type is not required for the application MSS. Specific diagnostics and their requirements should be listed in each paragraph when applicable.)

3.2.1.2.1.4.1 On-Line Diagnostics. On-line diagnostics shall be provided for the Radar segment. These diagnostics shall be self initiating during startup, and/or they may be executed as a background function during training mode.

(On-line diagnostics are those diagnostics that execute while the training system is in the real-time training mode. These diagnostics may run as a background task. An example that would be used in an MSS might be a segment functional diagnostic. Each diagnostic would tell the IOS segment that it was still functioning on a periodic basis (say once a minute). If the IOS does not receive the message then it assumes the segment is not functioning properly and provides a message to the instructor.)

3.2.1.2.1.4.2 Off-Line Diagnostics. Off-line diagnostics shall be provided by the Radar segment. Off-line diagnostics shall be executed when the _____ *(insert application aircraft type)* MSS is not engaged in a system mode.

(Off-line diagnostics are those diagnostics that are performed on a segment in the stand-alone or segment mode. Typical off-line diagnostics would include; hardware self tests, software testing, I/O debug programs, Daily Readiness at a segment level, etc.)

3.2.1.2.1.4.3 Remote Controlled Diagnostics. Remote controlled diagnostics shall be provided for the Radar segment. These diagnostics shall be executable, from the Instructor Operator Station (IOS), when the MSS is in the Remote Controlled Diagnostic mode.

(Remote controlled diagnostics are those diagnostics that run in the special remote controlled Diagnostic mode. These diagnostics require the system to be up and running and the segments communicating. An example of a Remote Controlled Diagnostic would be a real-time debugger.)

3.2.1.2.1.5 Backdoor Interfacing. The Backdoor interface support service shall provide the means to support external interfaces to the Radar segment. All ownship Radar system Input/Output (I/O) not specifically identified in the _____ *(insert application aircraft type)* MSS IDD shall interface via the MSS VNET. Backdoor interfaces shall not be utilized for normal intersegment communication.

(Specific external interfaces should be discussed in this paragraph. Backdoor interfaces may include a 1553 bus to installed aircraft avionics or a specialized interface to drive a Head Up Display (HUD). A backdoor interface may not be utilized to transmit intersegment data.)

3.2.1.2.1.6 Malfunctions. The malfunctions support service shall provide control for the processing and execution of Radar segment malfunctions. The system response shall be in accordance with aircraft design criteria.

(Radar segment malfunction requirements should be defined in a program unique Malfunction Description Document)

3.2.1.2.1.7 Damage Assessment. The damage assessment support service shall provide for the processing and implementation of any damage simulation for which the Radar segment is responsible. This shall include the degradation of the appropriate systems within the Radar segment based on an evaluation of the damage severity and location.

(Specific damage assessment and system degradation requirements should be specified in this paragraph which are consistent with the training requirements of the specific simulator.)

3.2.1.2.1.8 Security Processing. The Radar segment security processing support service shall provide processing to meet the security requirements of the _____ *(insert application aircraft type)* MSS Radar segment.

(This paragraph should be expanded to clearly specify which government directives apply and to what extent consistent with security considerations. Security processing would include Memory Erase Mode if required and any other security considerations, such as removable memory or special encoding devices.)

3.2.1.2.1.9 Scoring. The scoring support service shall provide the ability to assess Radar performance. The Radar segment scores shall be provided to the IOS segment via the MSS VNET.

(Application specific scoring data requirements for the Radar segment shall be listed in this paragraph. If large amounts of data are required it may be advisable to provide this as a non-real-time activity.)

3.2.1.2.1.10 Other Support Function Services. Not Applicable.

(Additional If there are other support functions unique to this segment they should be listed here, otherwise identify this paragraph as "Not Applicable". An example is intra segment communication. Before defining new functions be sure the function cannot be incorporated as a variant of an existing function.)

3.2.1.2.2 Radar Processor Function. The Radar Processor function shall simulate the performance characteristics of the _____ *(insert application aircraft type)* Radar Avionics Control Unit. This function shall produce outputs to crew station displays in accordance with _____ *(insert application aircraft type)* aircraft design criteria. The Radar Processor function shall provide data to other segments in accordance with the interface requirements specified in the _____ *(insert application aircraft type)* MSS IDD. Radar mode control shall reside within this function and shall be provided to the support function for output on the MSS VNET.

(The contents of this paragraph and its sub-paragraphs should be the Radar executive functions. These paragraphs should be tailored to the Radar executive functions and Interfaces required to support Radar node processing specified in the subsequent Radar Functions. Listed below are some of the key elements of this function:

a. Radar mode control will provide sequence control over the radar modes. It shall prioritize and order modes in accordance the design criteria. It may monitor mode progress and be capable of interrupting the in-progress mode for another higher priority node. It may perform confidence checks mode generated data and take corrective action if required.

b. Interface control to provide executive control over communication with other MSS segments and/or back-door communications. Included will be channel enabling or disabling, status monitoring, error checking.

c. Error reporting may be required to report detected radar errors to a central fault monitoring subsystem and/or a fault recording system. Included in this task would be the analysis of errors reported by the other radar functions and the testing of these against report criteria.

d. Power control simulation will provide for radar power-up or power-down sequencing and timing.

e. Inputs from the radar operator will be evaluated against the aircraft/ground geometry (in concert with the design criteria) to inhibit radar modes that cannot be supported. Examples of this would be commanding a radar map outside of the field-of-view of the radar or attempting to radiate on the ground or the commanding of incompatible radar parameters such as range scale, pulse repetition frequency, sector widths. The results of this process will be output to display functions and radar mode control processes.)

3.2.1.2.3 Radar Image Generation Function. The Radar Image Generation function shall generate visual imagery representative of the _____ *(insert simulated radar system)* radar system. This function shall produce outputs to the radar system displays in accordance with _____ *(insert application aircraft type)* aircraft design criteria. The Radar Image Generation Function's resolution, accuracy and display shall be in accordance with the _____ *(insert application aircraft type)* aircraft Radar performance specifications, with the following exception, the azimuth and range resolution and accuracy shall not be less than 0.5 of the specified values. This segment shall provide data to other MSS segments in accordance with the requirements of the _____ *(insert application aircraft type)* MSS IDD.

(The following items should be considered when specifying requirements for the Radar Image Generation function:

a. Radar part number or other identification that would help define the required simulation.

b. The environment(s) to be simulated: ground, airborne, ship. If the host is mobile, then the paragraph should be supplemented with the simulation requirements with respect to position, velocities and attitudes.

c. The displays to be supported by the simulation. For instance, a radar system often has multiple displays but it may be necessary only to support a subset of these.

d. The modes which shall be simulated such as real beam ground map, Doppler beam sharpening, weather detection, expanded offset, synthetic aperture radar, beacon, rendezvous, ground object indication or tracking, or a combination thereof.

e. The symbology to be included in the simulation such as range marks, cursor, heading mark, ground track mark, alphanumerics showing map or flight parameters, or other special characters.

f. Any special radar effects should be entered here such as jamming, far shore brightening, texturing, aspect simulation, glitter, seasonal effects, leading edge brightening, speckle, star effect etc. Special sub-paragraphs may be added to further specify the simulated effect required.

g. The specific documents or documentation group identification that defines the radar's performance capabilities.

h. Any reduction in performance levels permitted. For instance, the resolution of the radar simulated may not be required for the training mission and therefore may be scaled back to conserve costs. Other areas of conservation could be to eliminate display orientation or symbology requirements.

i. Any special simulation requirements that may exist. For instance, correlation with other simulated sensors (infrared, electro-optical, or visual), defensive system effects, weapon system effects or others.)

3.2.1.2.4 Airborne Interrogate Sensor Function. The Airborne Interrogate Sensor function shall provide an interface between the radar simulation, and the _____ *(insert application aircraft type)* MSS Identification Friend or Foe (IFF) simulation. This function shall produce outputs to the crew station displays in accordance with _____ *(insert application aircraft type)* aircraft design criteria. The Airborne Interrogate Sensor function shall provide data to other MSS segments in accordance with the interface requirements defined by the _____ *(insert application aircraft type)* MSS IDD.

((This paragraph must be tailored to meet the airborne interrogation requirements of the specific simulator program. The following items should be considered when specifying requirements for the Airborne Interrogate Sensor function:

a. Interpretation and validation of the instructor panel inputs which will normally be the IFF code.

b. The determination of the pattern to be displayed; intensity, range, and azimuth patterns in response to instructor inputs.

c. Formatting and transmission of the IFF pattern to the Image Generation function of the radar simulation for merging into the radar display.)

3.2.1.2.5 Radar Database Management Function. Not Applicable.

(The Radar Database Management function is a service function which is allocated to the Environment segment for the generic MSS. If this function is allocated to the Radar segment for a particular training system, then the requirements should be extracted from the Environment segment specification and transferred to this paragraph. The following items should be considered when specifying requirements for the Radar Database function:)

a. The area of database coverage required both on-line and in removable media.

b. The response time in mounting/dismounting removable media if exchange is required.

c. Database storage density both on-line and off-line.

d. The capacity to accept and use databases in standard formats.
e. Multiple database resolutions for use with the different radar modes such as real beam (low resolution/wide area coverage database) or with Synthetic Aperture Radar mode (high resolution/limited coverage).
f. Provisions for the control, storage, and acquisition of specialized databases such as Bomb Damage Assessment database, Weather database, or Relocatable Object database.
g. Interfacing to the instructor segment to acquire database control parameters and to post database status information.
h. The accuracy and resolution requirements on each required database.)

3.2.1.2.6 Radar Guidance Function. The Radar Guidance function shall simulate the performance characteristics of the _____ *(insert application aircraft type)* aircraft radar guidance systems. This function shall produce outputs to crew station displays in accordance with the _____ *(insert application aircraft type)* aircraft design criteria. The Radar Guidance function shall provide information to other MSS segments in accordance with the interface requirements specified in the _____ *(insert application aircraft type)* MSS IDD.

(The following items should be considered when specifying requirements for the Radar Guidance function:

a. Types of radar guidance to be simulated, e.g. terrain following, terrain avoidance
b. Display fidelity requirements such as accuracy, brightness, resolution, fixed and dynamic symbology.
c. Requirements to implement backdoor interfaces to video indicators, high speed busses or standard busses such as the MIL-STD 1553 databus.
d. Acceptance of electrical synchronization signal and the video overlay requirements or compliance with specific video signal formats.
e. Requirements to produce all displays concurrently.
f. The requirements to perform data processing using the terrain/culture database to produce specific data files representing a radar scan of the terrain in the flight path. This processing may include filling gaps in radar visibility or adding other quality codes to the data file such as weather or jamming indications.
g. Timing of display refreshes and/or interchange of Terrain Following data files with flight controlling software.
h. The requirement to simulate variable volume scans and scans that approximate the ground track path of the aircraft.
i. Application of motion compensation to the displays between radar scans.)

3.2.1.2.7 Mission Computer Interface Function. The Mission Computer Interface function shall provide sensor management and mode control interfaces between the Radar simulation and an embedded _____ *(insert application aircraft type)* aircraft mission computer. The Mission Computer Interface function shall produce outputs to the crew station displays in accordance with the

_____ *(insert application aircraft type)* aircraft design criteria. Data shall be provided to other MSS segments in accordance with the interface requirements specified in the _____ *(insert application aircraft type)* MSS IDD.

(If an embedded aircraft processor is not incorporated into the application trainer, then this paragraph should be indicated as "Not Applicable". The following items should be considered when specifying requirements for the Mission Computer Interface function:

a. Specific types of functions to be performed by this function, e.g. sensor fusion, sensor cueing, target data correlation, or threat assessment
b. Controls and displays which may be required for interface
c. Specific embedded aircraft equipment which this function must interface, model number, type, etc.)

3.2.1.2.8 Aircraft System Interface Function. The Aircraft System Interface function shall provide the interface between the Radar simulation and the _____ *(insert application aircraft type)* simulated electrical, hydraulic, waveguide pressurization and cooling systems. This function shall model the Radar system's response to the presence or absence of these supporting systems and produce outputs to the crew station displays in accordance with the _____ *(insert application aircraft type)* aircraft design criteria. Data shall be provided to other MSS segments in accordance with the interface requirements specified in the _____ *(insert application aircraft type)* MSS IDD.

(There may be no crew observable indications other than the illumination of a power indicator. If specific details of the aircraft to Radar system interface are known, they should be identified in this paragraph. The following items should be considered when specifying requirements for the Aircraft System Interface function:

a. The simulated response to selected power sources or to all power sources.
b. Loss of cooling and the Radar' response to the loss through simulated overheat warning indicators or the automatic shutdown of key radar system components.
c. Loss of hydraulics impact on the radar such as loss of antenna scan or possibly antenna attitude stabilization with the attendant display impact.
d. The modelling of loss of pressurization in the radar waveguide such as warning indications on the operator's displays or loss of transmitter ready status.
e. Consideration should be given to providing the capability to work around the loss of supporting resources.)

3.2.1.2.9 Crew Station Hardware Interface Function. The Crew Station Hardware Interface function shall provide the interface between the Radar simulation and the _____ *(insert application aircraft type)* MSS crew station. This function shall produce outputs to the crew station displays in accordance with the _____

(insert application aircraft type) aircraft design criteria. Data shall be provided to other MSS segments in accordance with the interface requirements specified in the _____ *(insert application aircraft type)* MSS IDD.

(This function may provide data between the Radar segment, and the crew station displays, either across the MSS VNET or as a backdoor connection directly to Radar electronics. Typically aircraft system performance is specified by references to design criteria and by providing tolerances. The following items should be considered when specifying requirements for the Crew Station Hardware Interface function:

a. Applicable IDDs or military or industry standards defining the electrical or communication formats to be used with each interface.
b. Any data reformatting or transformation required between the Radar function data and the required external format.
c. Any data transformation, sampling or other processing required to interface the Radar function data to the MSS IDDs.)

3.2.1.2.10 Spatial Relations Function. Not Applicable.

(This function is intended to serve as a position fixing, or range finding capability for the Radar segment. The Spatial Relations function is a service function which is allocated to the Environment segment for the generic MSS. If this function is allocated to the Radar segment for a particular training system, then the requirements should be extracted from the Environment segment specification and transferred to this paragraph. The following items should be considered when specifying requirements for the Spatial Relations function:

a. Specification and identification of Radar data elements to be generated and its format/coordinate systems.
b. Accuracy and resolution of each of the Radar generated data elements.
c. Transformation requirements including the definition of coordinate systems, transformation rates, and response times.
d. Requirements to compute estimates of errors for use by the navigation MSS. Many modern navigation systems employ a KALAMAN or similar filter which requires estimates of errors to accompany inputs from its sensors.)

3.2.1.2.11 Occulting Function. Not Applicable.

(The occulting function determines whether there is an obstruction between the ownship line-of-sight and another object. The Occulting function is a service function which is allocated to the Environment segment for the generic MSS. If this function is allocated to the Radar segment for a particular training system, then the requirements should be extracted from the Environment segment specification and transferred to this paragraph. The following items should be considered when specifying requirements for the Occulting function:

a. The type of occultation required: ownship to object, object to object, or both.

b. The number and rate that objects will be processed. To conserve resources, it may be feasible to provide a object processing rate that is a function of range from the aircraft.

c. Limits on range or altitude of an object along with default status definition when those ranges are exceeded.

d. The precision of the occulting calculations which is primarily a function of the resolution of the database being used.)

3.2.2 System Capability Relationships. The Radar segment shall support the system capability relationships defined in Volume I of this specification. Radar segment functional relationships shall be as described in the following paragraphs.

(Define any Radar segment unique capability relationships. In general, the capability relationships specified in Volume I will suffice for this segment.)

3.2.2.1 Segment Functional Relationships. The top level, typical, Radar segment functional relationships are depicted in FIGURE 1. Each function shall operate in a manner which will allow the segment, as a system, to satisfy the timing requirements described in Volume I of this specification. Functions implemented within the Radar shall operate in such a manner which will allow the segment to meet both segment and system level requirements without degradation.

(There are two approaches to describing inter-segment interfaces: all functions communicate through the support function, or all functions communicate directly with other functions. FIGURE 1 in all segments may have the same structure. For this segment, functions which are not implemented should be shaded out. If desired, functions which are only partially implemented may be graphically represented with cross hatching. Note that the intent of this diagram should be to identify "required" internal relationships and not to specify the segment's internal design. The tailoring of this paragraph should be done very carefully.)

3.2.3 External Interface Requirements. The Radar segment shall support the external interface requirements defined in Volume I of this specification and the _____ *(insert application aircraft)* MSS Interface Requirements Specification (IRS), _____ *(insert IRS document number)*. External interfaces comprise data passed between functions contained in the Radar segment and functions contained in the other MSS segments. With the exception of the dedicated interfaces for the cockpit, all other external interfaces which shall be used for the Radar segment are specified in the _____ *(insert application aircraft type)* IRS.

(Define Radar segment unique external interface requirements. Communications functions may interface with external systems which contain electronics equipment, such as amplifiers, noise or static generators, or Digital Signal Processors (DSP). If such equipment is required it should be identified in this paragraph.)

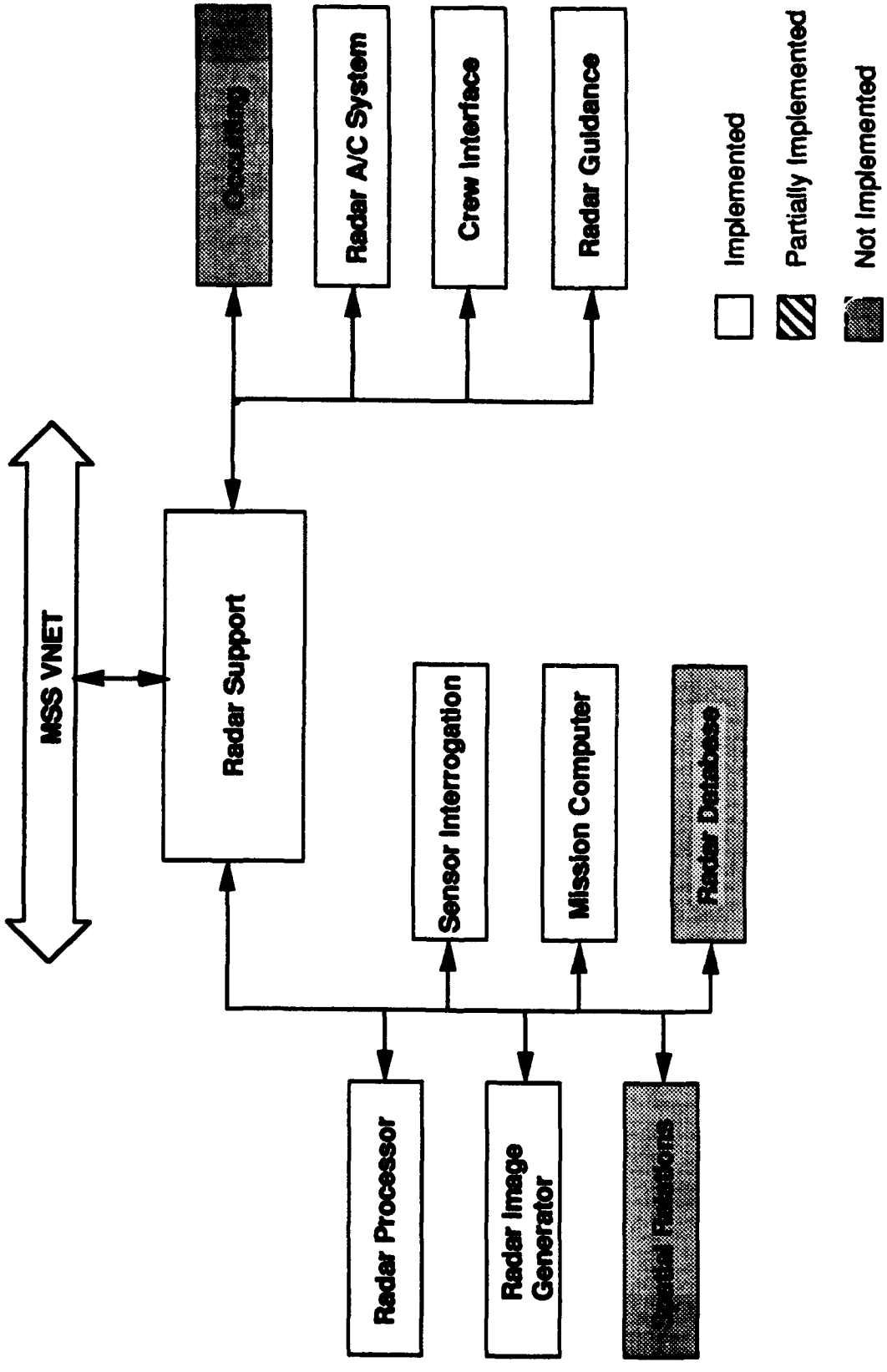

FIGURE 1 RADAR SEGMENT FUNCTIONAL RELATIONSHIPS

3.2.4 Physical Characteristics. The physical characteristics of the Radar segment shall meet the requirements as specified in Volume I of this specification. The Radar segment physical characteristics shall be of such design as to interface with the other MSS segments via the MSS VNET.

(Physical characteristic requirements for the Radar segment, other than those provided by the Radar segment computational system and its interface to the MSS VNET shall be defined in this paragraph. Physical characteristic requirements may include backdoor interface hardware to connect Radar segment I/O to the Radar equipment in the application aircraft cockpit; in particular, backdoor hardware interfaces may be required for the fire control and weapon stores panels in the Flight Station cockpit. In addition, any weight or size considerations applicable to the Radar segment should be considered.)

3.2.4.1 Protective Coatings. Radar segment protective coatings shall be as defined in Volume I of this specification.

(Additional protective coating requirements which are required for the Radar segment may be defined in this paragraph. In general, the requirements of Volume I should suffice for the entire system.)

3.2.5 Radar Segment Quality Factors

3.2.5.1 Reliability. The system level reliability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Radar segment reliability must be ___ % to satisfy the system level reliability requirements. The Mean Time Between Critical Failure (MTBCF) shall be not less than ___ hrs.

(A specific allocation of reliability (e.g. MTBF) for this segment should be specified in this paragraph. Reliability should be allocated to each segment in such a way that system level reliability requirements will be met. Normally, this means that segment reliability will be higher than system reliability.)

3.2.5.2 Maintainability. The system level maintainability requirements applicable to all segments in the MSS are defined in Volume I of this specification. The Radar segment shall have a mean corrective maintenance time, μ_C, of ___ minutes, and a 90th percentile maximum corrective maintenance time of ___ minutes to satisfy the system level maintainability requirements.

(Maintainability requirements such as MTTR should be allocated to each segment in such a way that system level maintainability requirements will be met. Normally, this means that segment MTTR will be higher than system MTTR. System level requirements will include isolation to faulty segment.)

3.2.5.3 Availability. The system level availability requirements applicable to all segments in the MSS are defined in Volume I of this specification.

(Usually availability applies only to the system level. Reliability and Maintainability (MTBF and MTTR) are allocated to each segment in such a way that system availability requirements will be met. It would be unusual to impose an availability requirement at the segment level.)

3.2.5.4 Additional Quality Factors. The additional quality factors, as defined in Volume I of this specification, shall apply to the Radar segment.

(Additional Radar segment unique quality factors may be defined in this paragraph. In general, the system level additional quality factors will suffice for the Radar segment.)

3.2.6 Environmental Conditions. The environmental condition requirements, as defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique environmental requirements. In general, the system level environmental conditions will suffice for the Radar segment.)

3.2.7 Transportability. The transportability requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique transportation requirements. There may exist unique transportation requirements to ship the segment from the segment contractors facility to the prime contractors facility. In general, the system level transportability requirements will suffice for the Radar segment.)

3.2.8 Flexibility and Expansion. The flexibility and expansion requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Unique requirements for this segment may include spare memory, spare time, spare mass storage, I/O channels by type, chassis expansion slots, etc. Expansion requirements should consider the likelihood this segment will need to change as well as the cost of including capability now versus cost to change later. Reuse of the segment in future applications should also be considered.)

3.2.9 Portability. The portability requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Except for field transportable trainers portability of hardware is usually not a requirement. Portability of software may be a concern of future changes which may include upgrading the Computer Hardware Configuration Item (HWCI) are considered likely. Use of a standard higher order language such as Ada is usually adequate to assure software portability.)

3.3 Design and Construction. The design and construction requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique design and construction requirements. In general, the system level design and construction requirements will suffice for the Radar segment.)

3.3.1 Materials. The materials requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique material requirements. In general, the system level material requirements will suffice for the Radar segment.)

3.3.1.1 Toxic Materials. The toxic materials requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique toxic materials requirements. In general, the system level toxic materials requirements will be applicable to all segments.)

3.3.2 Electromagnetic Radiation. The electromagnetic requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique electromagnetic radiation requirements. In general, the system level electromagnetic radiation requirements will suffice for the Radar segment.)

3.3.3 Nameplates and Product Marking. The nameplate and product marking requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique nameplate and product marking requirements. In general, the system level nameplate and product marking requirements will suffice for the Radar segment.)

3.3.4 Workmanship. The workmanship requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique workmanship requirements. In general, the system level workmanship requirements will suffice for the Radar segment.)

3.3.5 Interchangeability. The interchangeability requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique interchangeability requirements. In general, the system level interchangeability requirements will suffice for the Radar segment.)

3.3.6 Safety. The safety requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique safety requirements. In general, the system level safety requirements will suffice for the Radar segment.)

3.3.7 Human Engineering. The human engineering requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique human engineering requirements. In general, the system human engineering requirements will suffice for the Radar segment.)

3.3.8 Nuclear Control. The nuclear control requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique nuclear control requirements. In general, the system level nuclear control requirements will suffice for the Radar segment.)

3.3.9 Segment Security. The system security requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique security requirements. The Radar segment may have additional requirements to ensure declassification of an embedded Radar system. In general, the system level security requirements will suffice for the Radar segment.)

3.3.10 Government Furnished Property. Government Furnished Property (GFP) shall be as identified in Volume I of this specification.

(Identify any Radar segment unique GFP requirements. In general, the system level GFP requirements will suffice for the Radar segment.)

3.3.11 Computer Resource Reserve Capacity. The system level processing resource requirements applicable to all segments in the MSS are defined in Volume I of this specification.

(In addition to the computer resource reserve capacity identified in Volume I, the specific reserve capacity for the Radar segment may include the computational system hardware and software required to design, develop, and test the Radar segment. System considerations such as spare (time, memory, storage, I/O channels) for growth unique to this segment should be imposed here. If this paragraph requires subparagraphs they should follow the numbering and topics used in Volume I.)

3.4 Documentation. The documentation requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique documentation requirements. Documentation requirements for the Radar segment may include interface specifications and design data for interfacing to an

embedded Radar system. In general, the system level documentation requirements will suffice for the Radar segment.)

3.5 Logistics. The system level logistics requirements applicable to the Radar segment shall be as specified in Volume I of this specification, paragraph 3.5, and all subparagraphs of paragraph 3.5.

(Unique support requirements for this segment should be described here. These may include special tools and jigs for installation, alignment and calibration; special environmental conditions for operation and repair such as a clean-room for component repairs; levels and types of spares required.)

3.6 Personnel and Training. The system level personnel and training requirements, defined in Volume I of this specification, shall apply to the Radar segment.

(Identify any Radar segment unique personnel and training requirements. In general, the system level personnel and training requirements (number, skills and training for maintenance personnel) will suffice for the Radar segment.)

3.7 Subordinate Element Characteristics. Not applicable.

(This volume defines requirements for a subordinate element of the MSS. In general, there will be no subordinate elements of a segment.)

3.8 Precedence. The precedence requirements for the Radar segment shall be as specified in Volume I of this specification.

4. QUALIFICATION REQUIREMENTS

4.1 Responsibility For Test and Inspection. The _____ *(insert application aircraft type)* MSS Responsibility For Test and Inspection requirements are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Radar segment.

(This paragraph may be tailored to identify additional test or inspection requirements which are specific to the Radar segment.)

4.2 Special Tests and Examinations. The system level general qualification events, levels, and methods of testing for the Radar segment are defined in Volume I of this specification. The requirements defined in Volume I shall apply to the Radar segment.

(Clearly identify which test events defined in Volume I apply to this segment. Be particularly explicit about the segment builder's responsibility during system integration and test. To the extent possible, segment verification should be accomplished as a stand alone segment test. In some cases verification can only be achieved in the integrated mode. A clear definition of the Segment supplier's responsibility during systems integration should be contained in the SOW.)

4.3 Requirements Cross Reference. A requirements compliance cross reference matrix shall be developed to ensure requirement verification traceability. The requirements cross reference matrix shall be included as part of the Radar segment Prime Item Development Specification (PIDS).

5. PREPARATION FOR DELIVERY

The _____ *(insert application aircraft type)* MSS preparation for delivery requirements, as defined in Volume I of this specification, shall apply to the Radar segment.

(Segment unique requirements may include packaging the segment for shipment to the integration location which could be different than packaging the system for shipment to the installation site. If requirements are imposed here, there may be test requirements for verification which must be added to Section 4.)

6. NOTES

6.1 Intended Use. The _____ *(insert application aircraft type)* MSS shall be used as an integral part of the _____ *(insert application aircraft type)* aircraft training system.

6.1.1 Missions. The Radar segment shall support the mission requirements defined in Volume I of this specification. The Radar segment shall provide simulation and training in cockpit familiarization, Radar operating procedures, and mission procedures for the _____ *(insert application aircraft type)* aircraft Radar systems. The Radar simulation shall provide familiarization with the cockpit configuration and operation of the _____ *(insert application aircraft type)* Radar systems. The simulation shall provide an environment to gain proficiency in executing normal procedures, recognize malfunctions/abnormal indications and executing the corresponding emergency procedures, and in executing mission procedures.

(The Radar segment mission is to support the trainer mission, as described in Volume I. Any mission specific information should be described in this section. An example might be a segment intended to support a family of trainers, such as, a procedures trainer, part task trainer, flight trainer, or weapon system trainer.)

6.1.2 Threat. Not applicable.

(This paragraph shall describe the threat which the Radar system is intended to neutralize. In this context, this paragraph is not applicable to most simulators, and will generally remain "Not applicable".)

6.2 Radar Segment Acronyms. The acronyms contained in this paragraph are unique to the Radar segment and are in addition to the MSS acronyms contained in Volume I of this specification.

(Considerations may be given to including conversion factors or unique coordinate system definition.)

DOD	Department of Defense
GFP	Government Furnished Property
IDD	Interface Design Document
IFF	Identification Friend or Foe
I/O	Input/Output
IOS	Instructor Operator Station
IRS	Interface Requirements Specification
MSS	Modular Simulator System
MTBCF	Mean Time Between Critical Failure

PIDS Prime Item Development Specification

VNET Virtual Network

6.3 Glossary of Radar Segment Terms. The terms contained in this paragraph are unique to the Radar segment and are in addition to the MSS terms contained in Volume I of this specification.

IDENTIFICATION FRIEND OR FOE (IFF) - A system which interrogates other aircraft to determine their identity. Equipment used in this system consists of an on-board interrogator, a transponder in the other aircraft which receives the interrogation signal and transmits a coded reply signal, and a responder to produce a display output.

JAMMING - Intentional transmission, or re-radiation of radio frequency signals, to interfere with reception of desired signals by the receiver.

OCCULTING - Obstructing the line-of-sight between the ownship and another object. Terrain is a common feature which causes occulting. Objects not part of the terrain may also cause occulting, such as man-made cultural features or atmospheric conditions.

POSITION FIXING - A technique for utilizing radar range to a known point for determining navigation system errors. The error between the actual and navigation system velocities and positions are corrected to the real-world position.

RADAR GUIDANCE - Use of radar returns to provide flight guidance to the ownship. Radar guidance may include terrain avoidance, terrain following, or ground returns for manual flight.

SENSOR FUSION - The capability to integrate sensor data from multiple sources to provide a coherent data output for enhanced situational awareness.

TERRAIN AVOIDANCE - A form of radar guidance which provides a display of the terrain obstructions along the flight path.

TERRAIN FOLLOWING - Radar guidance technique which provides flight path information to the crew for flying nap-of-the-earth flight profiles. System may be integrated with an automatic flight control system to provide an automatic terrain following capability.

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REVISIONS

LTR	DESCRIPTION	DATE	APPROVAL
A	BMAC-STS-86-303-1 Total revision required to incorporate changes required by testing/validation efforts and Government comments.	90/01/11	A. Clem Prepared By
		90/01/11	Checked By
		91/01/14	Dwg. Qual.
		90/01/11	Supervised By
		91/01/15	Approved By
B	CCP HSV-H91-008 Total revision required to incorporate changes resulting from addition of two new specifications and new functional allocation. Damage Assessment and Scoring were added to the module support function. The Height Above Terrain function was deleted. The Radar Database/Gaming Area function was modified into a service function with reference to the Tactical and Natural Environments (TNE) module. The Radar Image Generation function was modified to reference environmental data from the TNE module.	91/06/26	Prepared By
		91/06/26	Checked By
		91/06/26	Dwg. Qual.
		91/06/27	Supervised By
		91/06/27	Approved By

DD-6000-4530 ORIG. 12/87

REVISIONS

LTR	DESCRIPTION	DATE	APPROVAL
C	CCP HSV-H91-008 Total revision required to incorporate Government comments on document.	91-09-26 91-09-26 91/09/26 91-09-26 91-10-08	K. Kelley Prepared By S M Hunter Checked By J Bue Dsg. Qual. S M Hunter Supervised By W F Tucker Approved By
D	CCP HSV-H91-017 This specification volume has been totally revised to: 1. Change the format to comply with DI-CMAN-80008A. 2. Incorporate the tailoring instructions into the body of the text. The incorporation of tailoring instructions into each specification volume has caused a change in the number of specification volumes from fourteen to thirteen. Prior to this change, all tailoring instructions were provided in Volume XIII and Volume XIV contained the Tactical and Natural Environment segment specification. The content of Volume XIII has been integrated into the other specification volumes. The change is summarized as follows: Volume / IS / WAS I through XII — Titles for these volumes are unchanged XIII — Environment — Tailoring Instructions XIV — "Deleted" — Tactical and Natural Environment	93-08-23 93-08-23 93-08-23 93/08/24	PREPARED CHECKED SUPERVISED APPROVED

DD-6000-4830 ORIG. 12/87